



IMPROVING EDUCATION DELIVERY AND LEARNING OUTCOME FOR SPECIALLY-ABLED CHILDREN WITH AUTISM SPECTRUM DISORDER

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ABSTRACT - Nowadays Autism children find it difficult to interact socially with people's emotions and make themselves isolated. People can identify a common face and understand a facial expression in a single glance. Still, children with autism spectrum disorder (ASD) frequently have problems communicating with their parents, care-takers, and other children. In this paper, we provide an inventive system to discover facial expressions in children with ASD during study time. Children are monitored while learning or using their electronic devices like tablets or laptops while the research tracks the child's facial expressions. The project we've proposed is an Emotion recognition for autism spectrum disorder children (ASD). It is self-possessed of python libraries Open CV, Haar-cascade method to predict faces. Contrarily, majority of the existing methods depend upon the detection of facial expressions of people in social media platforms namely Snapchat which uses facial recognition technology, and also from their facial expressions in the image the emotions get detected. And for better involvement of the children's social interaction, a face is captured in real-time and the emotions are processed by Facial expression recognition (FER). This developed system helps to build on Autism children's actions as they constantly observe their facial expressions and speculate the facial emotion. If the Predicted facial Emotion is happy, then we will play some Interesting Audio to them using AT mega Microcontroller and DF mini-Player, which will keep them relaxed and will help them to learn interactively. Along With that we have designed and built a stress sensor based on Galvanic Skin Response (GSR), to find their stress level and monitoring it via over the Internet Using NodeMCU (ESP8266-12E Microcontroller unit). This proposed system helps to develop the Autism children's actions as they often observe the facial indications of people and try to imitate their actions which make a huge difference in their understanding behaviour and also making it as a Non-Invasive Therapy for the ASD children because it does not possess the child to take any pills in order to calm them or to keep them in control.

Keywords- autism spectrum disorder (ASD), Non-Invasive therapy, OpenCV, Learning, Facial Expression Recognition (FER), Stress Detection Using Galvanic Skin Response sensor, Internet of Things, Data Storage.

I. INTRODUCTION

Cognitive skill development is an essential phase of any child's continuous growth process which primarily involves detailed concentration, memory and thinking. Children with autism are the ones who go through a

different development cycle than the ones who are normal by birth. Autism or Autism Spectrum Disorder (ASD), refers to a broad range of conditions characterized by challenges with social familiarity, frequent actions, speech and verbal communication. The common threads are the differences in social familiarity, communication, and get compared with people who are not on the diapason. Autism Disorder and lower

intelligence were set up among children who don't attain expression/ fluent speech, with verbal intelligence and social engagement arising as the strongest predictors of outgrowth. Frequently the caretaker or parent finds it hard to keep a record of every similar precise progress of the child. Therefore, if there's a system that can keep a regular track to dissect their development as well as be a good tool to keep them busy, also it may improve their development process. Since technology these days has its touch in nearly every sphere of our lives, therefore the operation of technology for the development of autistic children is a matter of consideration. The main idea of this system is to capture an image in real-time and also emotions whether it's a mortal face using the Computer Vision fashion. After detecting the faces from an image, and observe the facial expressions using Deep Neural Network and If the detected facial Emotion is happy, also we will play Rhymes Audio to them which will help them to learn effects interactively, therefore getting an educational tool grounded on emotional intelligence, Along With that we've designed and integrating Sweat conductance discovery detector grounded on Galvanic Skin Response(GSR), to find their stress position and covering it via over the Internet Using Node MCU(ESP8266- 12E Microcontroller unit) if the sprat's emotion isn't stable also we will give them with non-invasive remedy which will help them ameliorate the rotation of blood and make them feel calm and composed.

II. RELATED WORKS

T. Zaki et al., "Towards developing a learning tool for children with autism," 2017 6th International Conference on Informatics, Electronics and Vision & 2017 7th International Symposium in Computational Medical and Health Technology (ICIEV-ISCMHT), Himeji, Japan, 2017, pp. 1-6, doi: 10.1109/ICIEV.2017.8338597, Suggested that the Autism or Autism Spectrum Disorder (ASD) characterizes a wide range of refining disabilities related social communication and behaviour. The technological elaboration of smart devices and operations has created several accessible approaches to deal with similar illness effectively and fluently. Although, a simple education is a necessary for everyone, but teaching autism children through basic approach is still tough. Also, ICT grounded literacy software that has been developed for autistic kiddies are also facing the commerce (e.g., how autistic kids may interact with the literacy software or bias) challenges. Thus, the end of their paper was about introducing a cost-effective, movable and admin-friendly interactive education tool to give autistic children with introductory academics. Their tool consists a pressure analysing keypad to give a simple and responsive means of behaviour for autistic children. The tool is also evaluated

in a laboratory environment to assess its effectiveness and usability.

URL:https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&ar_number=8338597&isnumber=8338503

E.Linstead, R.German, D.Dixon, D. Granpeesheh, M. Novack and A. Powell," A working of Neural Networks to Predicting Mastery of Learning outcome in the Treatment of Autism Spectrum Disorder," 2015 IEEE 14th International Conference on Machine Learning and Applications (ICMLA), Miami, FL, USA, 2015, pp.414-418, doi10.1109/ICMLA.2015.214, They have proposed that they have applied artificial neural networks to the task of prognosticating the mastery of learning issues in response to behavioural remedy for children diagnosed with autism diapason complaint. they have reported results for a sample size of 726 children, the largest sample size reported was for a study of this nature to date. their results show that neural networks mainly outperform the direct retrogression models reported in former studies, and demonstrate the benefits of using more sophisticated machine literacy ways in the autism exploration.

URL:https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&ar_number=7424348&isnumber=7424247 .

B. Kamala, K. S. Mahanaga Pooja, S. Varsha and K. Sivapriya, "ML Based Approach to Detect Autism Spectrum Disorder (ASD)," 2021 4th International Conference on Computing and Communication Technologies (ICCCT), Chennai, India, 2021, pp.313-318, doi: 10.1109/ICCCT53315.2021.9711826. In this paper they've explained that the Autism Spectrum Disorder is an exponential disorder which causes notable challenges in community interaction and behaviour for the people affected. Autism children may have issues in interconnecting with humans and learning the word's meaning for them is really challenging. Parents observe strange actions from autism children like lack of coordination and looping of physical movements such as rotating, waving their hands in a rapid manner, uncontrollable shaking of head and body. Autism Spectrum Disorder (ASD) cannot be cured but makes a vast difference in the lives of many children if early treatment is provided. And, ASD is termed as lifelong challenging disorder. Based on the complexity of the disorder, symptoms, the cause for ASD changes. Genetics and environment play a biggest role. Children having weak X syndrome and other genetic illness or children of aged parents or exposed to environmental toxins leads to result in autism. In China, 1 out 9000 children and in India, 23 out of 10000 children are affected. soon detection is needed to improve good treatment and enhance the quality of life of ASD suffering humans. Unfortunately, there is no effective test to detect Autism. Autism disorder is normally detected by scanning the activities of the children. Their

method of diagnosis is very time consuming and not suitable for soon detection. Their paper mainly focuses on using ML model to examine Autism at a sooner stage. ML models are usually working with the commitment among many brain regions and therefore are preferred over other tests. Moreover, machine learning algorithms are characterized with more accuracy over other methods. So, ML which is a subfield of Artificial Intelligence, can be taken to improve the detection methods of Autism by searching its genetics and modelling effective interventions.

URL:https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&ar_number=9711826&isnumber=9711757 .

III. SYSTEM ANALYSIS

A. Existing System

As with any pupil, children with autism benefit most when preceptors and parents are on the same runner and sweats in the home and at academy are mutually probative (Organization for Autism Research). Before planning an assignment, the schoolteacher should first meet with parents to bandy the possibility of a class assignment about autism. It's important to get parent input, and if applicable, input from the pupil with autism as well. The main disadvantages of this system are, teacher needs to take care of only one child at a time and sometime this system is not effective, when the kids become restless or get anxiety attacks it becomes very difficult to calm the kid with the existing method.

B. Proposed System

Face recognition comes under the domain of Computer Vision which is an approach to identify and recognize images. Currently, they are being applied to various applications to solve real-world problems in many fields such as industries, manufacturing, healthcare, etc., for public security, marketing, banking, etc. Social media platforms have advanced algorithms capable of performing various functionalities in facial recognition to attract a wider user base. The main objective of this system is to capture an image in real-time and then recognize whether it is a human face using the Computer Vision technique. After detecting the human faces from an image, and observe the facial expressions using Deep Neural Network and If the Predicted facial Emotion is happy, then we will play Rhymes Audio to them which will help them to learn things interactively, thus becoming an educational tool based on emotional intelligence, Along With that we have designed and integrating Sweat conductance detection sensor based on Galvanic Skin Response (GSR), to find their stress level and monitoring it via over the Internet Using Node MCU (ESP8266-12E Microcontroller unit) if the kid's emotion is not stable then we will provide them with non-

invasive therapy which will help them improve the circulation of blood and make them feel calm and composed.

For this objective, we must calculate the different conductance of the skin when a person is under stress or when not using Galvanic Skin Response (GSR) device.

III.SYSTSEM ARCHITECTURE

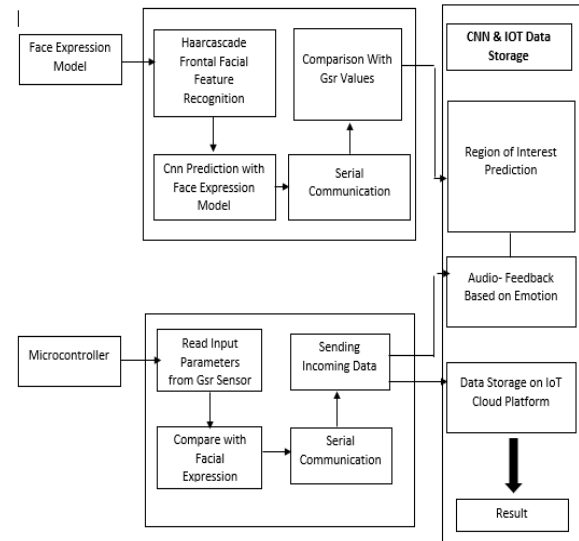


Fig 1. Proposed System Architecture.

V. MODULES

COMPUTER VISION

Computer vision is a field of artificial intelligence (AI) that enables computers and systems to decide meaningful information from digital images, vids and other visual inputs and take conduct or make recommendations grounded on that information. However, computer vision enables them to see, observe and understand, If AI enables computers to suppose. Computer vision works much the same as mortal vision, except humans have a head start. Mortal sight has the advantage of continuances of environment to train how to tell objects piecemeal, how far down they are, whether they're moving and whether there's commodity wrong in an image. It trains machines to perform these functions, but it has to do it in much lower time with cameras, data and algorithms rather than retinas, optical jitters and a visual cortex. Because a system trained to check products or watch a product asset can dissect thousands of products or processes a nanosecond, noticing inappreciable blights or issues, it can snappily surpass mortal capabilities.

GALVANIC SKIN RESPONSE(GSR)

The GSR detector is grounded on skin resistance that varies with the state of sweat glands in the skin. mortal body sweating is regulated by the Autonomic Nervous System (ANS) therefore a Sweat conductance discovery detector grounded on Galvanic Skin Response (GSR), to find their stress position and covering it. If the sympathetic branch (SNS) of the autonomic nervous system is largely aroused, sweat gland exertion also increases, which in turn increases skin conductance, and vice versa. In this way, skin conductance can be a measure of the mortal Sympathetic Nervous System responses. A similar system is directly involved in the emotional behavioral regulation in humans.

DEEP NEURAL NETWORK

A deep neural network is a neural network with a certain position of complexity, a neural network with farther than two layers. Deep neural networks use sophisticated fine modeling to exercise data in complex ways. A neural network, in general, is a technology erected to pretend the exertion of the mortal brain – specifically, pattern recognition and the passage of input through various layers of simulated neural connections. Deep neural networks as networks that have an input caste, an affair caste and at least one hidden caste in between. Each caste performs specific types of sorting and ordering in a process that some relate to as “point scale.”

HAAR-CASCADE

Haar waterfall is an algorithm that can descry objects in images, irrespective of their scale in image and position. This algorithm isn't complicated so it can run in factual-time. We can train a haar waterfall sensor to describe colorful objects like buses, bikes, structures, fruits, etc. Haar Cascade classifiers are an effective way for discovering the objects. Haar Cascade is a machine knowledge- rested approach where a lot of positive and negative images are used to train the classifier. This algorithm needs a greater number of positive images of faces and negative images of non- faces to teach the classifier. A Haar classifier, or a Haar waterfall classifier, is a machine learning object discovery program that identifies objects in an image and videotape.

NODE MCU

The Node MCU is an open-source software that tackle development terrain that's erected around a veritably affordable System-on-a-Chip (SoC) called theESP8266. The ESP8266, designed and manufactured by Expressive

Systems, contains the pivotal rudiments of a computer CPU, RAM, networking (Wi-Fi), and indeed an ultramodern operating system and SDK. That makes it an excellent choice for Internet of effects (IoT) systems of all kinds. However, as a chip, the ESP8266 is also hard to pierce and use. You must solder cables, with the applicable analog voltage, to its legs for the simplest tasks similar as powering it on or transferring a keystroke to the “computer” on the chip. You also have to program it in low- position machine instructions that can be interpreted by the chip tackle.

FACIAL EXPRESSION RECOGNITION

Facial expression recognition is an intuitive reflection of a person's internal state, which contains rich emotional information, and is one of the most important forms of interpersonal communication. It can be used in colorful fields, including psychology. It's the technology that analyses facial expressions from both stationary images and vids in order to reveal information on one's emotional state. It's used for assaying sentiments by different sources, similar as filmland and vids. It belongs to the family of technologies frequently appertained to as ‘affective computing’, a multidisciplinary field of exploration on computer's capabilities to fete and interpret mortal feelings and affective countries and it frequently builds on Artificial Intelligence technologies. The features of the active facial expression emotion area are the first member of active facial expression area from the original face image and also to prize the real features of the area.

VI. BLOCK DIAGRAM

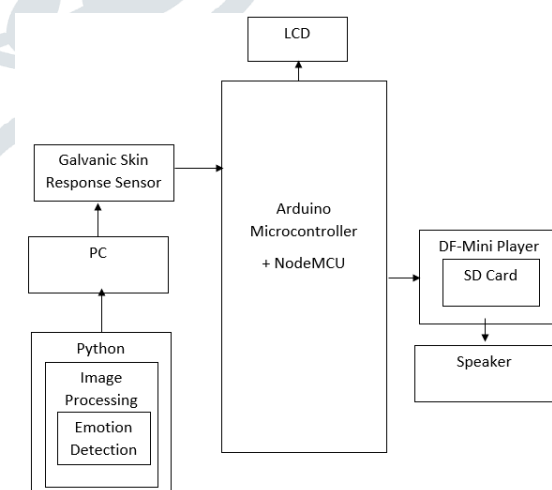


Fig 2. Block Diagram

VI. TECHNOLOGY STACK

Operating System: Windows

Language: Python.

Back End: Data Storage to Understand Recovery Pattern

Hardware Tools: Arduino mega Microcontroller, Node MCU Microcontroller, LCD Display, GSR Sensor, DF mini player, Speaker.

Fig 4. NodeMCU

VII. PROOF-OF-CONCEPT SYSTEM

The following are the screenshots of the hardware components which we have combined and will be connected with the software for recognition and recovery.

Hardware Requirements:

1. Arduino mega microcontroller
2. Node MCU
3. GSR sensor
4. DF mini player
5. LCD display
6. Speaker – output.

ARDUINO MEGA MICROCONTROLLER

Arduino is a single-board microcontroller to make using electronics in multidisciplinary systems more accessible. The tackle consists of a simple open-source hardware board designed around an 8-bit Atmel AVR microcontroller, or a 32-bit Atmel ARM. The software consists of a standard programming language compiler and a charge haul that executes on the microcontroller.

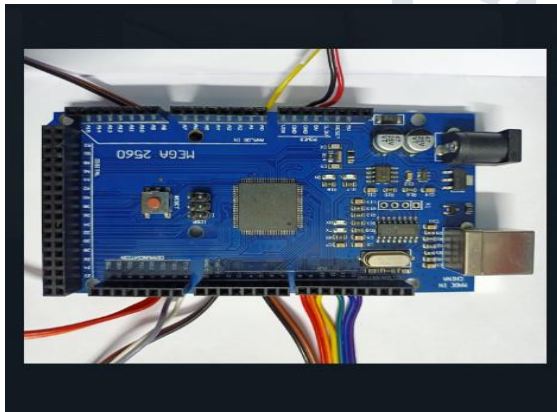
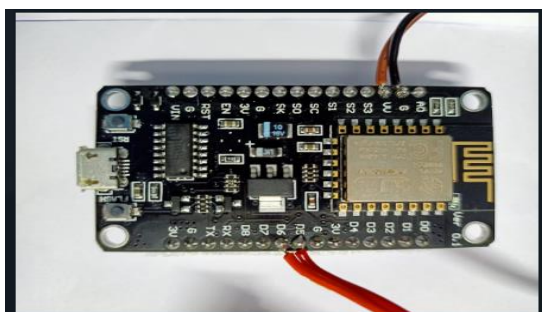


Fig 3. Arduino MCU

NODE MCU MICROCONTROLLER - Node MCU (ESP8266-12E Microcontroller unit) is used to monitor the stress level by connecting with the GSR sensor.



GSR SENSOR – GSR stands for galvanic skin response and it's a system of measuring the electrical conductance of the skin. Strong feelings can beget encouragement to your sympathetic nervous system, performing further sweat being buried by the sweat glands. Grove - GSR allows you to spot similar strong feelings by simply attaching two electrodes to two fritters on one hand. It's an intriguing gear to produce emotion related systems like sleep quality examiner.



Fig 5. GSR Sensor

DF MINI PLAYER

The DF Player Mini is a small and low-price MP3 module with a simplified affair directly to the speaker. The module can be used as a stage alone module with attached battery, speaker and the push buttons are used in combination with an Arduino UNO or any other with RX/ TX capabilities.

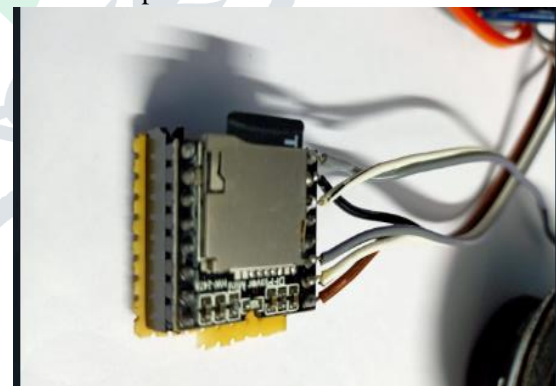


Fig 6. DF Mini Player

LCD DISPLAY

Liquid Demitasse displays (LCDs) have accoutrements which combine the parcels of both liquids and chargers. Rather than having a melting point, they've a temperature range within which the motes are nearly as mobile as they would be in a liquid, but are grouped together in an ordered form analogous to a demitasse.

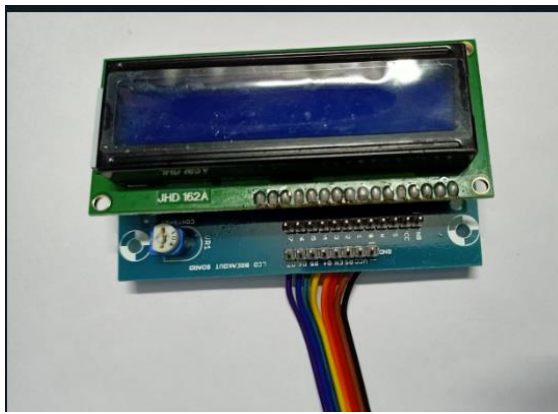


Fig 7. LCD Display

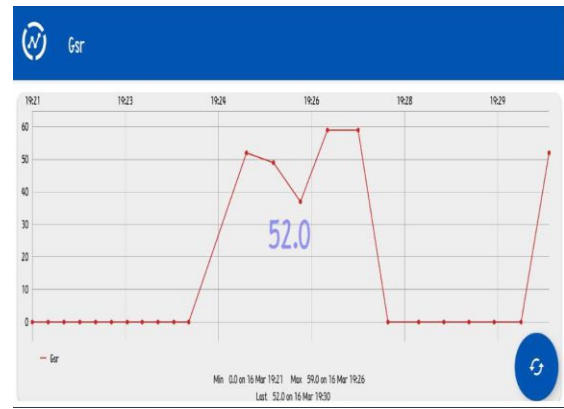


Fig 10. GSR Graph

SPEAKER

Speaker is an output hardware device that connects to Arduino mega microcontroller and DF mini player. It plays audio like music, clap sound, rhymes etc. which is loaded in the memory card.

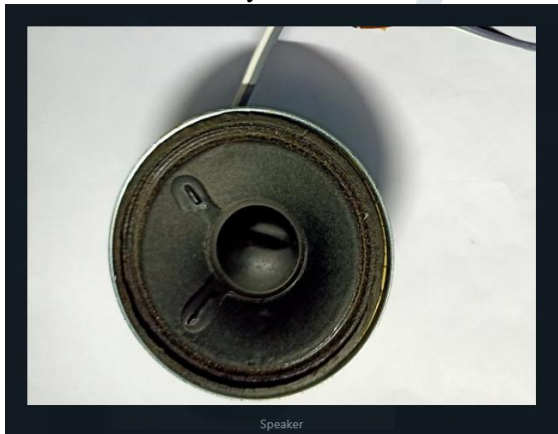


Fig 8. Speaker

Browser login – For this monitoring, we have used “mathwork” to control and manage (admin use), with this we’ll be able to give access to anyone i.e.,parent/Guardian to install and view about their child’s status(stress).

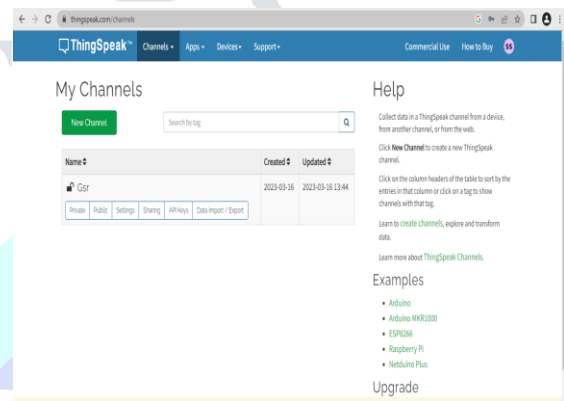


Fig 11. Admin managing

HARDWARE COMBINATION OUTPUT

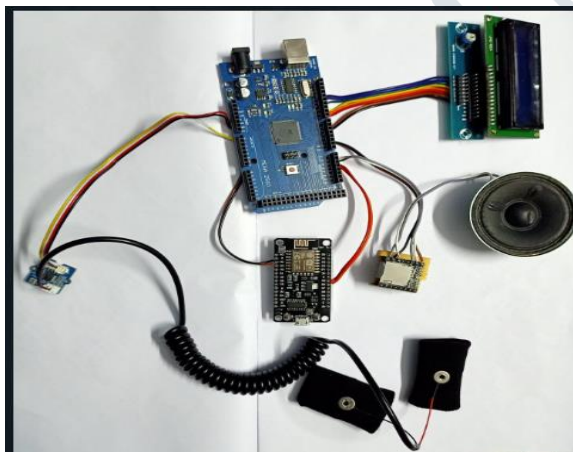


Fig 9. Hardware output

By clicking on the channel id’s password we will get access and can view the status of stress level in graphical representation manner.

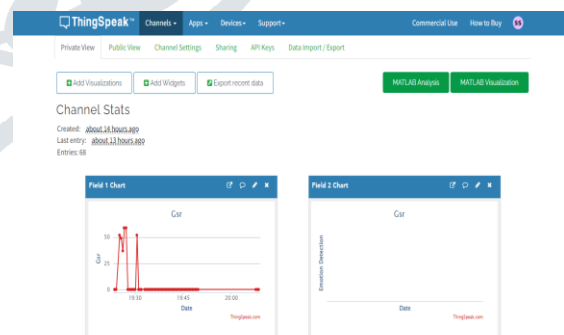


Fig 12. Channel Stats.

OUTPUT:

Mobile Monitoring – This application helps us to view the child’s sweat count (stress level) by their parent/ Guardian/Teacher.

To check about the data, we have to click the Data Import / Export.

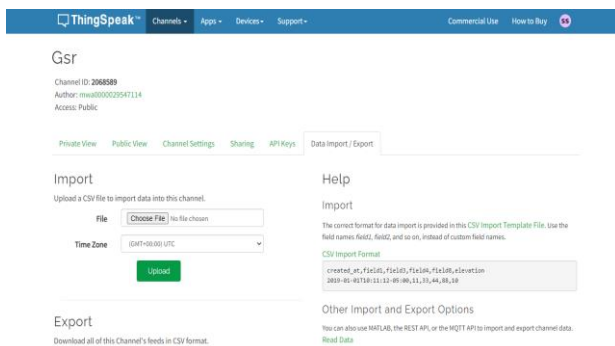


Fig 13. Data Exporting

Then we can download the whole data in excel sheet manner.

created_at	entry_id	status	latitude	longitude	elevation status
2023-03-08T19:21:23+05:30	1	0	Neutral		
2023-03-08T19:21:40+05:30	2	0	Neutral		
2023-03-08T19:22:17+05:30	3	0	Neutral		
2023-03-08T19:22:34+05:30	4	0	Neutral		
2023-03-08T19:23:01+05:30	5	0	Neutral		
2023-03-08T19:23:40+05:30	6	0	Neutral		
2023-03-08T19:23:05+05:30	7	0	Neutral		
2023-03-08T19:23:22+05:30	8	0	Neutral		
2023-03-08T19:23:30+05:30	9	0	Neutral		
2023-03-08T19:23:05+05:30	10	0	Neutral		
2023-03-08T19:24:11+05:30	11	0	Neutral		
2023-03-08T19:25:14+05:30	12	0	Neutral		
2023-03-08T19:25:42+05:30	13	0	Neutral		
2023-03-08T19:26:11+05:30	14	0	Neutral		
2023-03-08T19:26:40+05:30	15	0	Neutral		
2023-03-08T19:27:13+05:30	16	0	Neutral		
2023-03-08T19:27:45+05:30	17	0	Neutral		
2023-03-08T19:28:18+05:30	18	0	Neutral		
2023-03-08T19:28:45+05:30	19	0	Neutral		

Fig 14. Excel Sheet

Thus, the data that have been stored can be viewed by downloading the excel sheet.



Fig 15. Emotion Detection

Detecting their face's emotion in order to know their state (Face Emotion Recognition).

IX. CONCLUSION

Hence, we conclude that the main objective of this system is to capture an image in real-time and then recognize whether it is a human face using the Computer Vision technique. After detecting the human faces from an image and observe the facial expressions using Deep Neural Network and if the Predicted facial Emotion is happy, then we will play some Interesting Audio to them using AT mega Microcontroller and DF mini-Player, which will keep them relax and will help them to learn. Along

With that we have designed and built a stress detector using Galvanic Skin Response (GSR).

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